

Gases in the Atmosphere

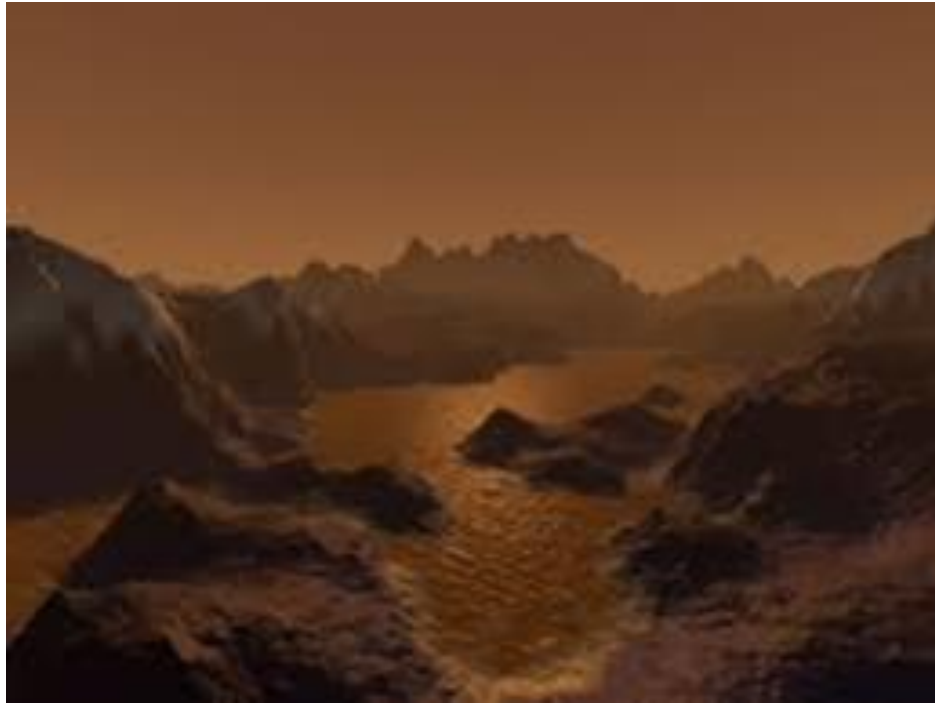


Outcomes:

Identify the abundances of the naturally occurring gases in the atmosphere & examine how these abundances have changed over time. *Include: Oxygenation of the atmosphere, role of biota, CO₂ content over time.*

History of the Atmosphere

It is believed that the composition of our atmosphere was dramatically different before there was life on earth. It consisted mainly of CARBON DIOXIDE (CO_2), AMMONIA (NH_3), METHANE (CH_4), and WATER (very little free OXYGEN).



<http://prehistorict.blogspot.ca/2012/03/new-research-suggests-that-earths-early.html>



https://en.wikipedia.org/wiki/Atmosphere_of_Titan

Atmosphere of Titan
(Believed to be similar to earth's early atmosphere)

Where did all the oxygen come from?

- U.V. radiation penetrated the dense atmosphere, and sparked **CHEMICAL REACTIONS** that lead to **LIFE** on earth.
- About 1 billion years later, **BLUE-GREEN ALGAE** appeared.
- The algae converted CO₂ and WATER into free **OXYGEN** gas and **GLUCOSE** through **PHOTOSYNTHESIS**, and bound hydrogen into carbonates and water.
- U.V. light also decomposed WATER into free oxygen gas.
- As the amount of O₂ gas increased, the **OZONE (O₃)** layer began to form.
- The **OZONE** layer filtered out U.V. radiation, allowing more **COMPLEX** species to develop.
- As more **CARBON** was extracted from the **ATMOSPHERE**, the early life forms provided a **FOOD** supply that fuelled **EVOLUTION**.
- As these organisms **DIED** and **DECAYED**, they provided large quantities of fossilized **MINERALS**, and a layer of **FERTILE SOIL**.

It is estimated that **1x10³** tonnes of carbon was extracted from the atmosphere in this way.

Composition of the Atmosphere...

The following table lists the relative abundance of the different gases in the atmosphere at sea level in 2000:

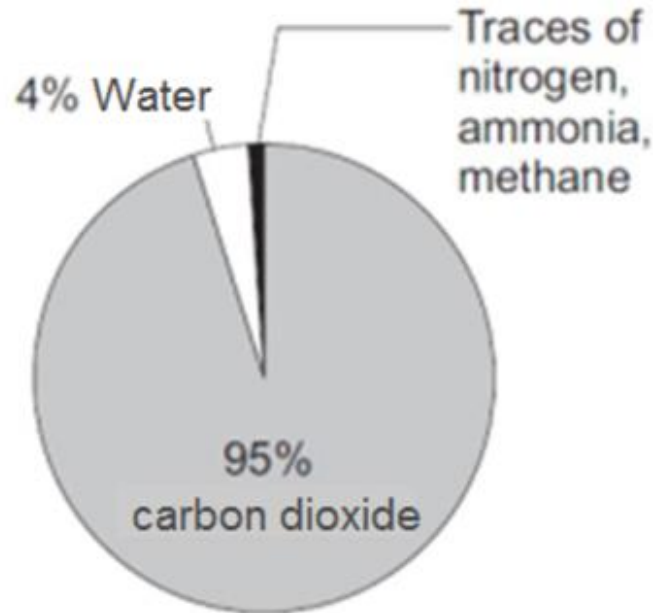
Composition		
Gas	Volume (%)	Volume (ppm)
N ₂	78.08	7.808 x 10⁵
O ₂	20.95	2.095 x 10⁵
Ar	0.934	9.34 x 10³
CO ₂	0.036	3.60 x 10²
Ne	0.001818	18.18
He	0.000524	5.24
CH ₄	0.0002	2
Kr	0.000114	1.14

1 ppm = ***1 molecule of the gas in 1,000,000 molecules of "air"***.

Composition of the atmosphere...

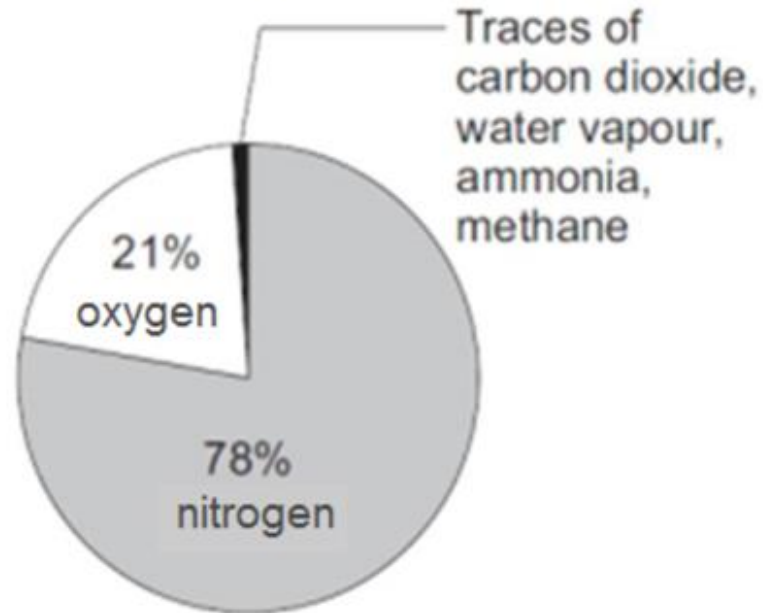
Notice the significant difference between the original composition of the atmosphere, and the composition today.

Earth's early atmosphere



Average surface temperature above 400 °C

Earth's atmosphere today

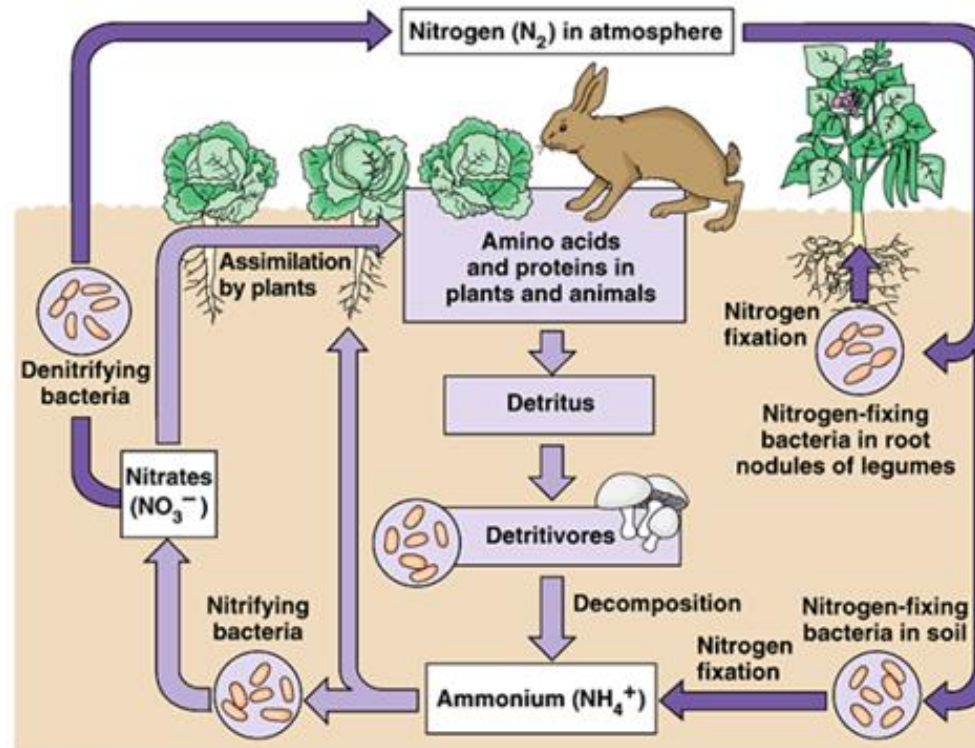


Average surface temperature 20 °C

How are these gases cycled...

Nitrogen

Much of the nitrogen in the atmosphere enters through **VOLCANIC ERUPTIONS**, burning **BIOMASS**, and **DENITRIFICATION**. Nitrogen is deposited on earth by nitrogen fixing **BACTERIA** and **LIGHTNING**. It is an important nutrient for **PLANTS**.



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<https://pmgbiology.com/2014/04/12/nitrogen-cycle-for-igcse-biology/>

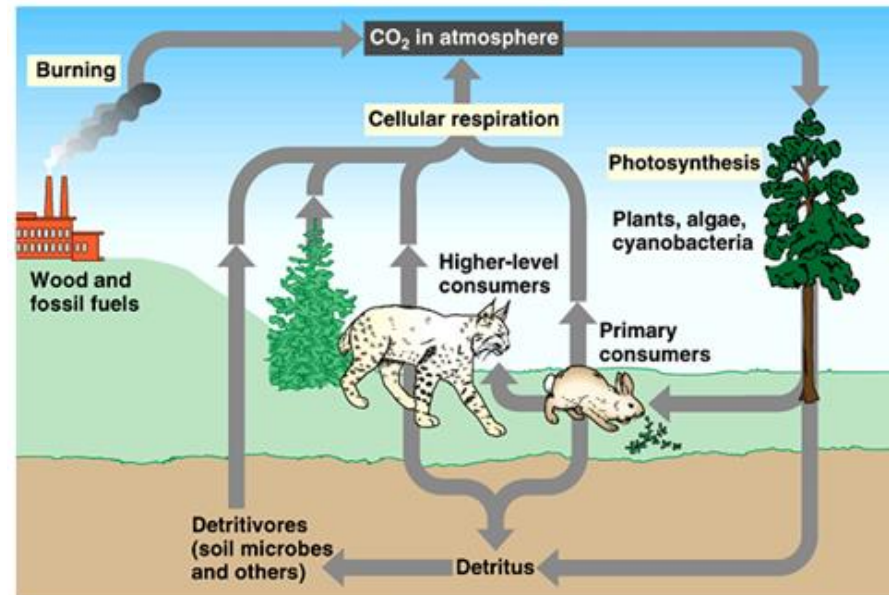
How are these gases cycled...

Oxygen

Deposited by **PHOTOSYNTHESIS**, and used in **RESPIRATION**, and **COMBUSTION**.

Carbon Dioxide

Enters the atmosphere by **COMBUSTION** of **FOSSIL FUELS**, **VOLCANIC ERUPTIONS**, **RESPIRATION**. It is removed by **PHOTOSYNTHESIS** and **DISSOLVING** in the **OCEANS** to make carbonic acid. It is important in controlling the **TEMPERATURE** of the atmosphere.



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<http://www.cpalms.org/Public/PreviewResourceLesson/Preview/75793>

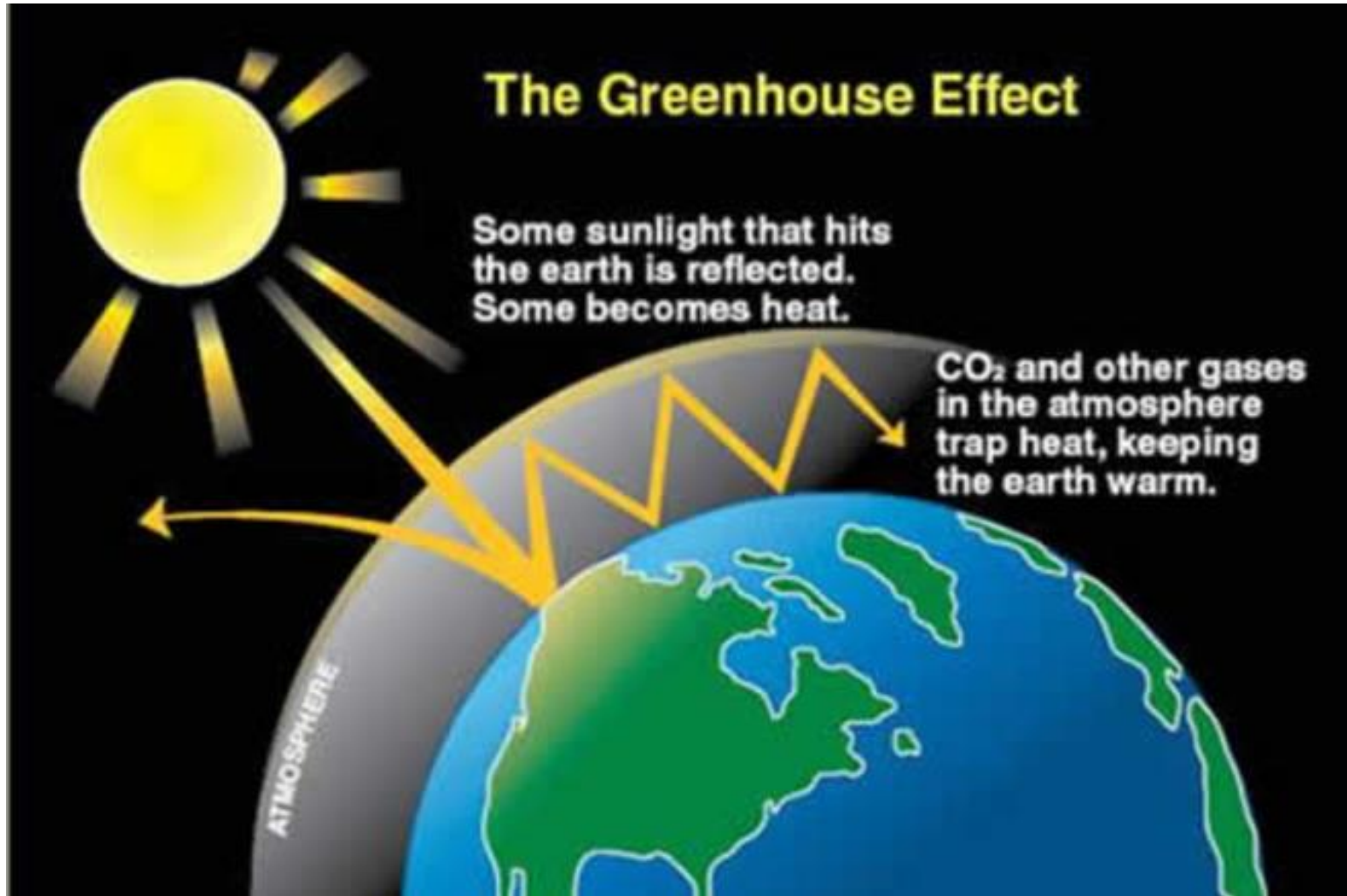
Increase of CO₂ in the Atmosphere...

- Since the industrial revolution, the amount of CO₂ in the atmosphere has increased by nearly **30%**
- Much of the CO₂ emissions are the result of burning **FOSSIL FUELS**.
- CO₂ is considered to be a **GREENHOUSE** gas, since it **REFLECTS** the sun's **RADIATION** back to the earth.
- Global mean temperatures have risen by about **0.5-1.0°C** since the late **19th century**.
- Polar **ICE CAPS** have **MELTED**, causing a rise in ocean **LEVELS**.
- More **WATER** and higher **TEMPERATURES** mean more **EVAPORATION**, which causes increased **PRECIPITATION**.

Increase of CO₂ in the Atmosphere...

Year	CO₂ Concentration (parts per million volume)	Temperature Anomaly (°C above/below normal)
1840	280	-0.40
1955	310	-0.05
1960	312	0.00
1965	316	-0.10
1970	320	-0.08
1975	327	-0.08
1980	335	-0.08
1985	345	+0.10
1990	352	+0.15
1995	355	+0.25
2000	360	+0.28

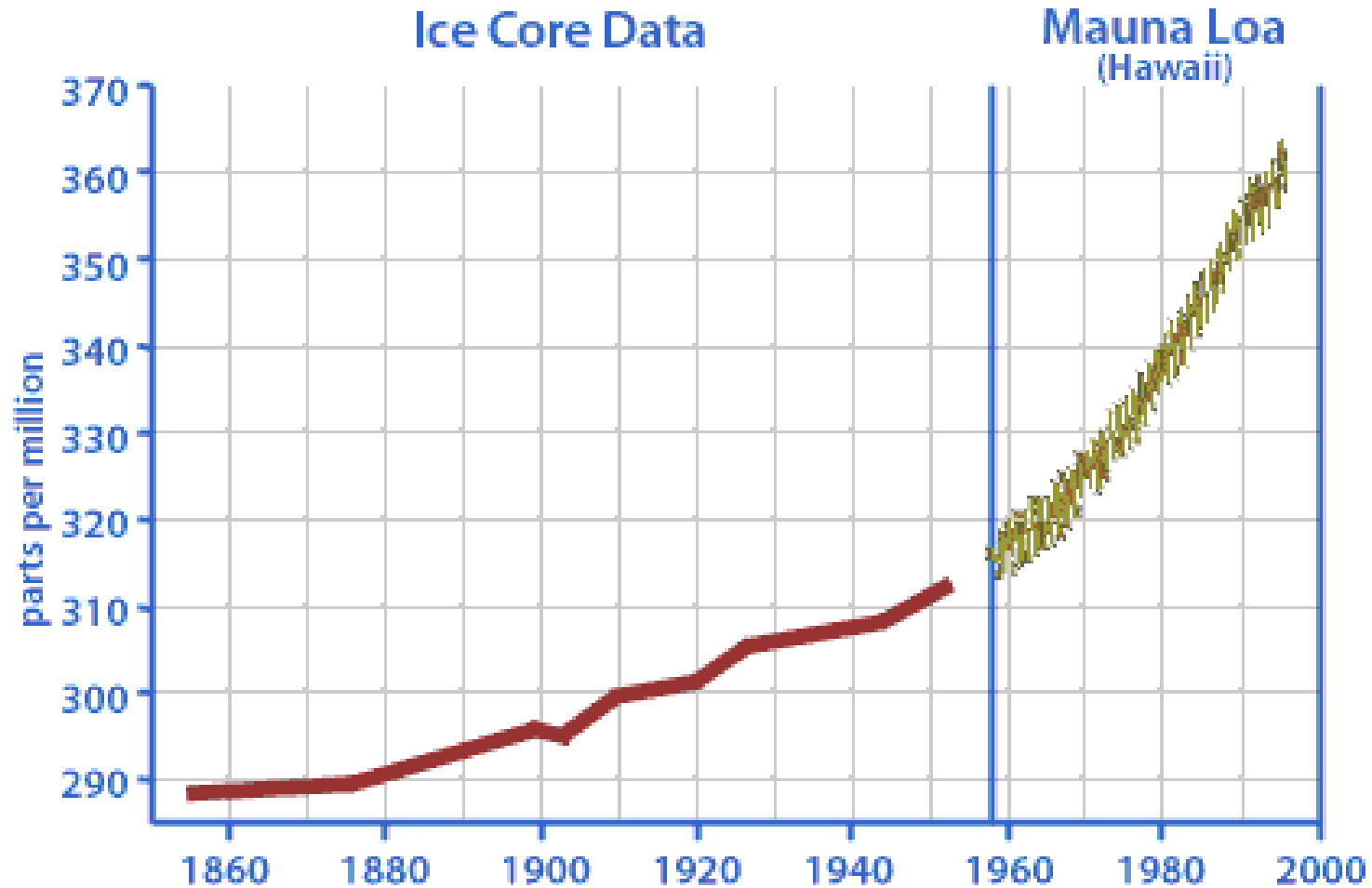
Increase of CO₂ in the Atmosphere...



<http://www.hotel-r.net/nl/greenhouse-effect>

Increase of CO₂ in the Atmosphere...

Carbon Dioxide Concentrations



<http://www.cotf.edu/ete/modules/climate/GCcarbon1.html>